(12)UK Patent Application (19)GB (11) 2025513 A

(21) Application No 7923940
(22) Date of filing
10 Jul 1979
(23) Claims filed
10 Jul 1979
(30) Priority data
(31) 78/29938
(32) 14 Jul 1978
(33) United Kingdom (GB)
(43) Application published
23 Jan 1980
(51) INT CL³ E05F 15/20
(52) Domestic classification
E2M 11F2 12A 21 24 25
(56) Documents cited
None
(58) Field of search
E2M

(71) Applicants
TB Colman & Sons Limited
104 Tamworth Road
Hove
Sussex
BN3 5FW

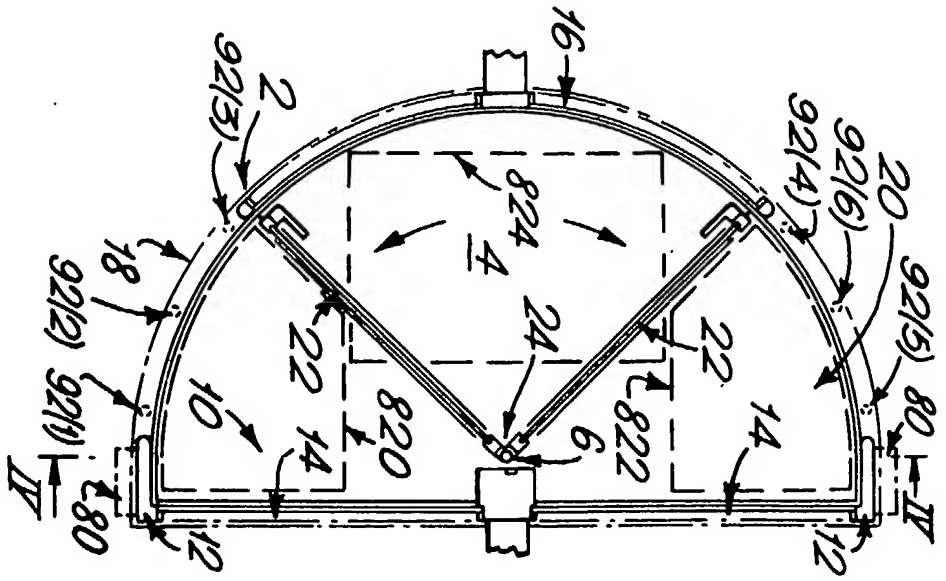
(72) Inventors
Christopher Herridge
Richard Gordon Colman

(74) Agents
A A Thornton & Co

(54) Control of security doors

(57) A security door permitting entry and exit of authorised persons comprises a pair of door leaves 22 connected together along a common edge defining a pivotal axis 6 and spaced to define a door compartment 4 and the door is mounted within a semi-cylindrical frame 16 formed with inlet and outlet ports 18,20. The door compartment is movable between the inlet and outlet ports, through the intermediate closed position shown, by a drive means and is positively braked when this means is not energized. An electronic system controls the operation of the door which is arranged normally to take up its intermediate position within the frame, and when actuated first brings the door compartment into communication with the frame port adjacent the intending user then brings the door compartment into communication with the other frame port and finally returns the compartment to its intermediate position.

FIG.2.



GB 2025513 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

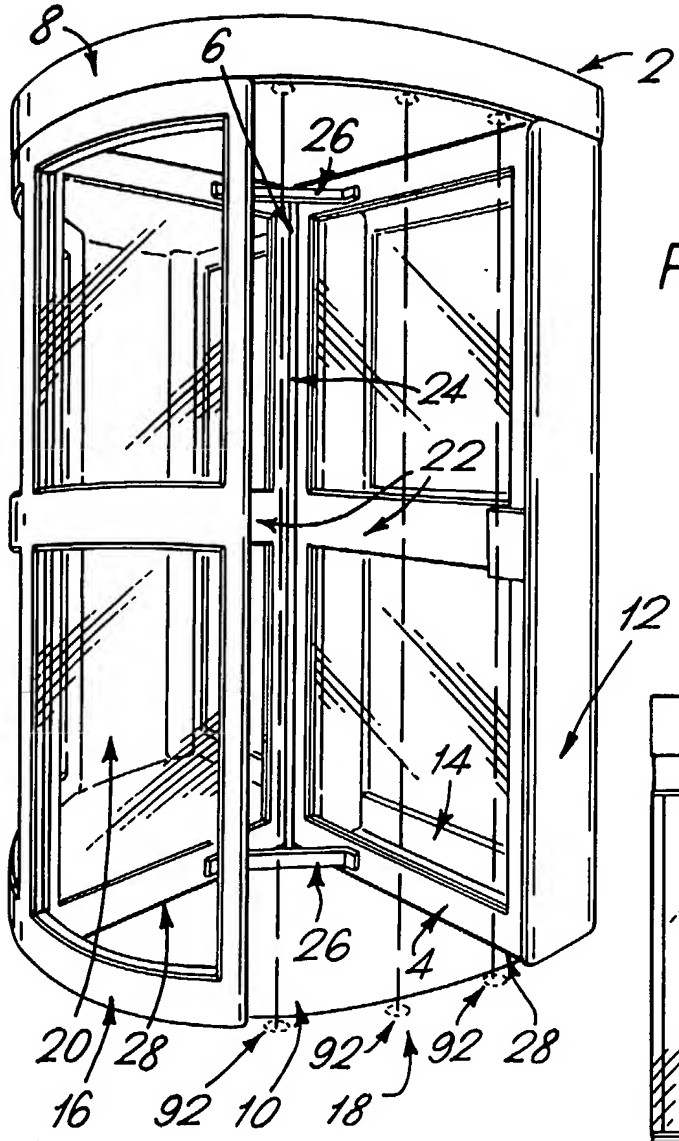


FIG.1.

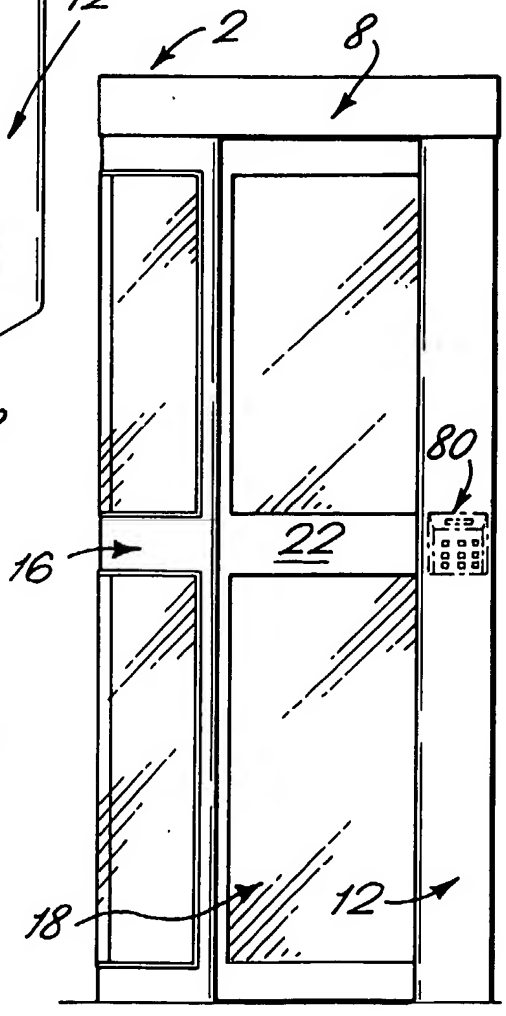


FIG.3.

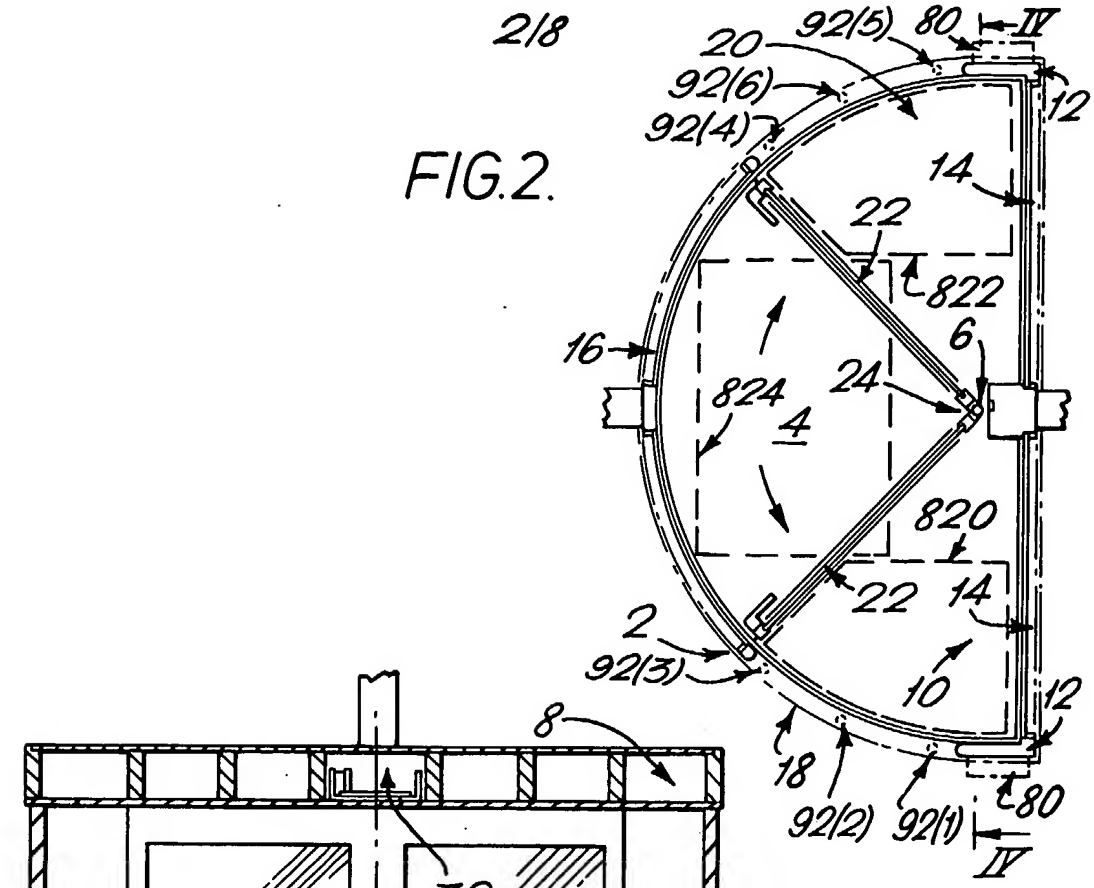

218
20
92(5)
80
IV
92(6)
92(4)
12
14
22
822
16
6
824
24
4
820
22
14
2
92(3)
10
12
8
18
92(2)
92(1)
80
IV

FIG.2.

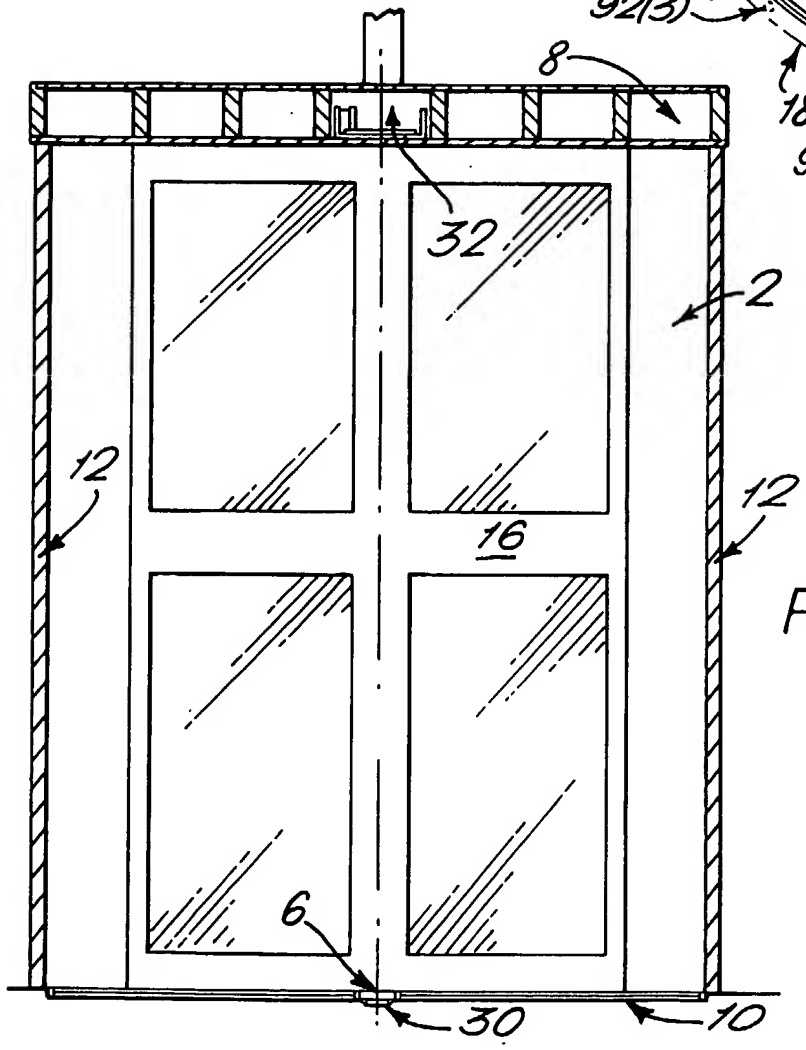
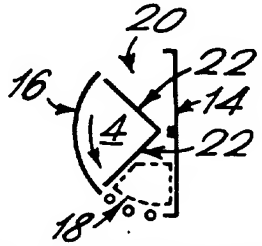
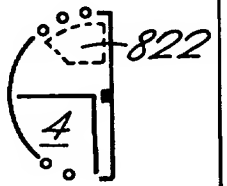
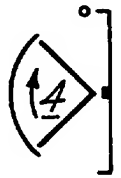
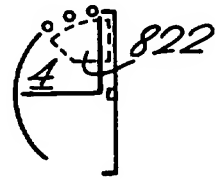
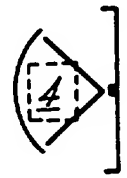

32
2
12
12
16
6
30
10

FIG.4.

FIG.5.

5/1	5/2	5/3	5/4	5/5
				
BY THE OPERATION OF A 'CARD READER' UNIT THE REVOLVING LEAVES WILL ROTATE TOWARDS THE OPERATIVE. THE PHOTO SWITCHES AND MAT ARE OPERATIVE. THE COMMENCING CYCLE CANNOT BE INTERUPTED BY THE OPERATION OF THE OPPOSING OR SAME 'CARD READER' BY ANOTHER PERSON.	THE PERSON MAY NOW ENTER THE CUBICLE. AFTER A 3 SECOND DELAY THE PHOTO SWITCHES AND MAT BECOME OPERATIVE.	THE REVOLVING LEAVES ROTATE UNDER POWER 90° AT APPROX' 4 R.P.M. TOWARDS THE OPPOSITE EXIT. THE PHOTO SWITCH SHOWN IS OPERATIVE.	THE REVOLVING LEAVES STOP AND THE PERSON NOW LEAVES THE CUBICLE. AFTER A 3 SECOND DELAY THE PHOTO SWITCES AND MAT SHOWN BECOME OPERATIVE.	THE REVOLVING LEAVES RETURN TO THEIR NORMAL POSITION AND AUTOMATICALLY LOCK. THE DOOR IS NOW READY TO START A NEW CYCLE IF REQUIRED. UPON REACHING THIS POSITION THE MAT SHOWN BECOMES OPERATIVE.

3/8

2025513

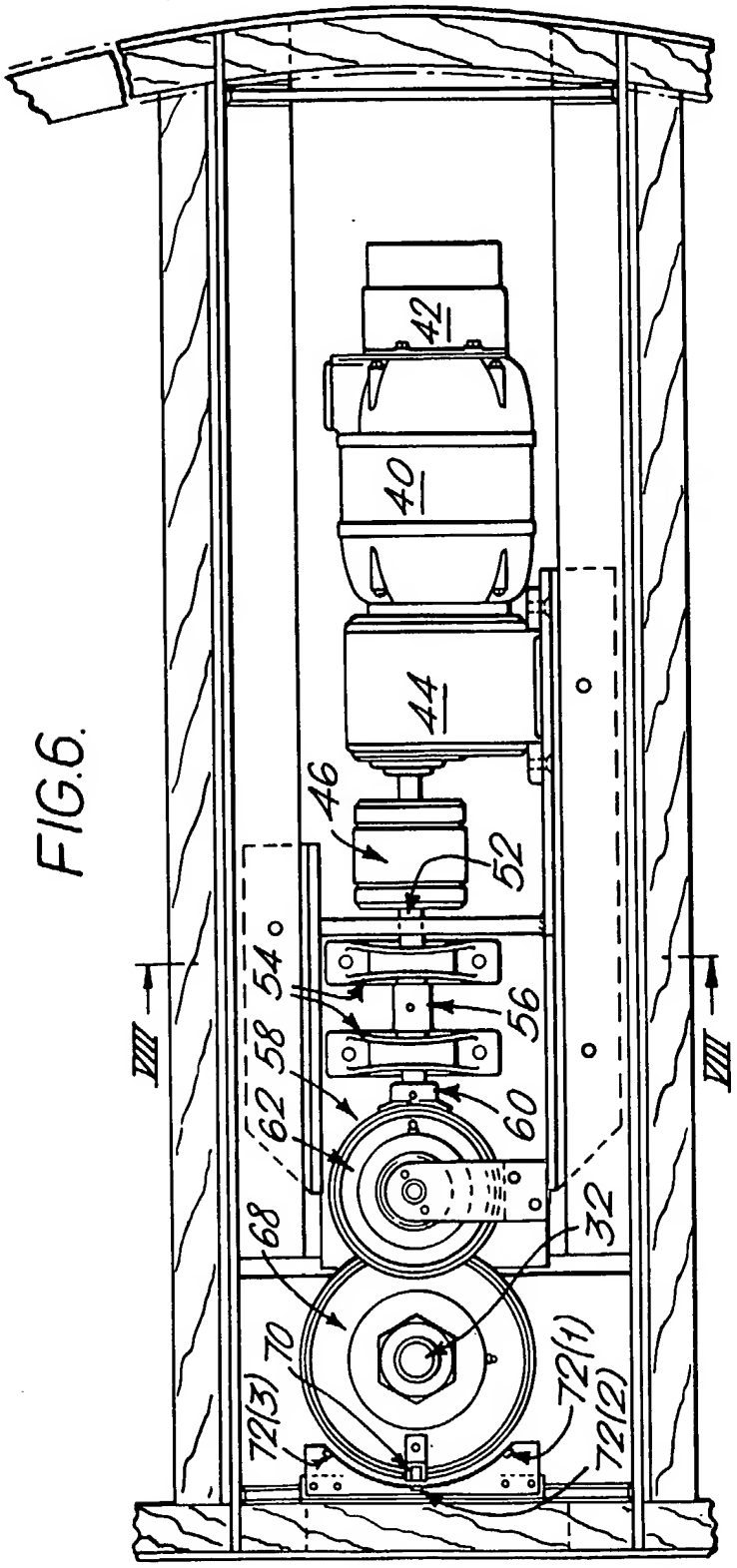


FIG.6.

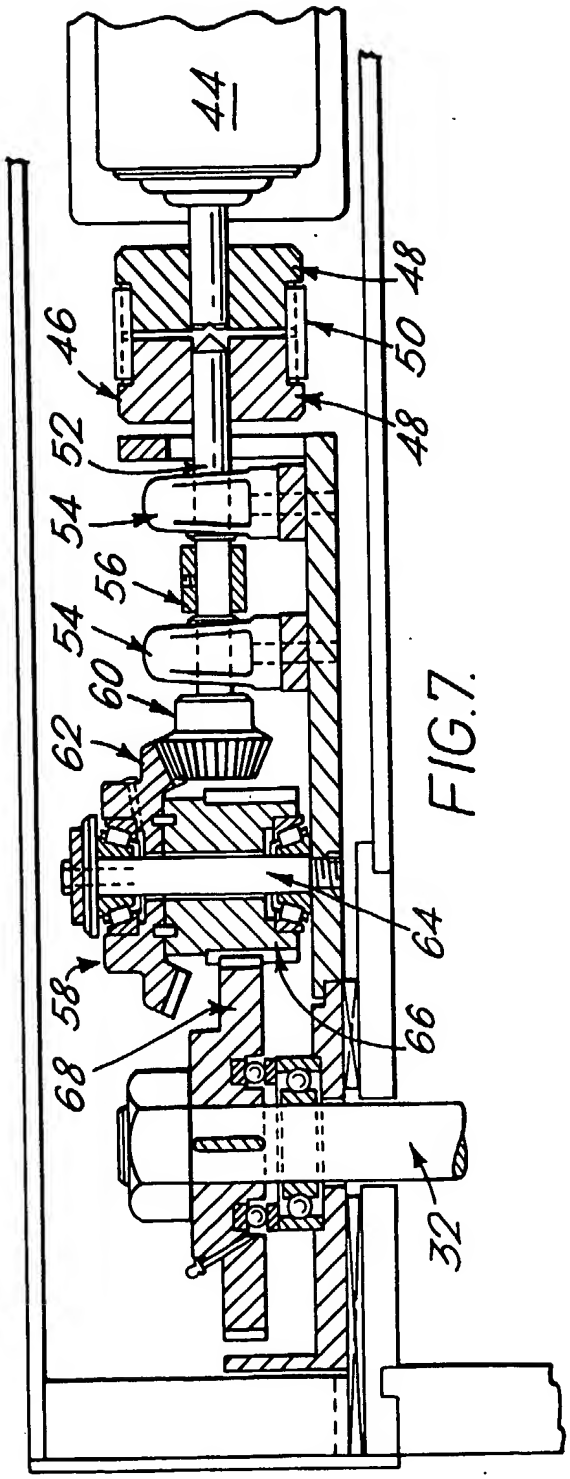


FIG.7.

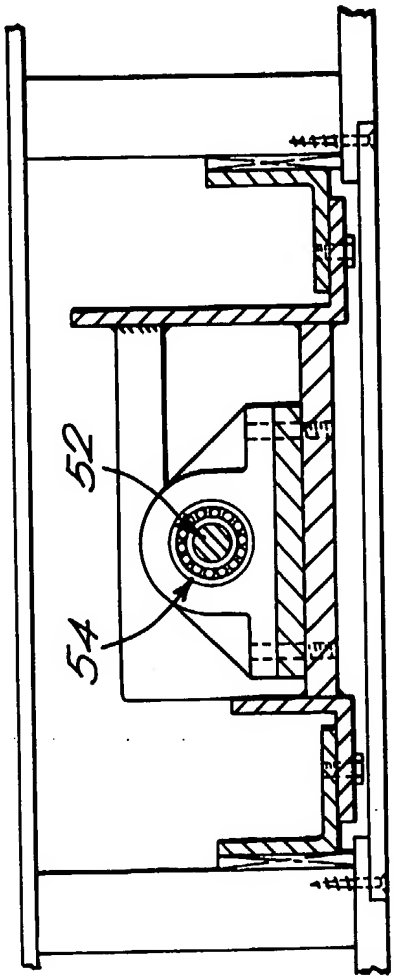
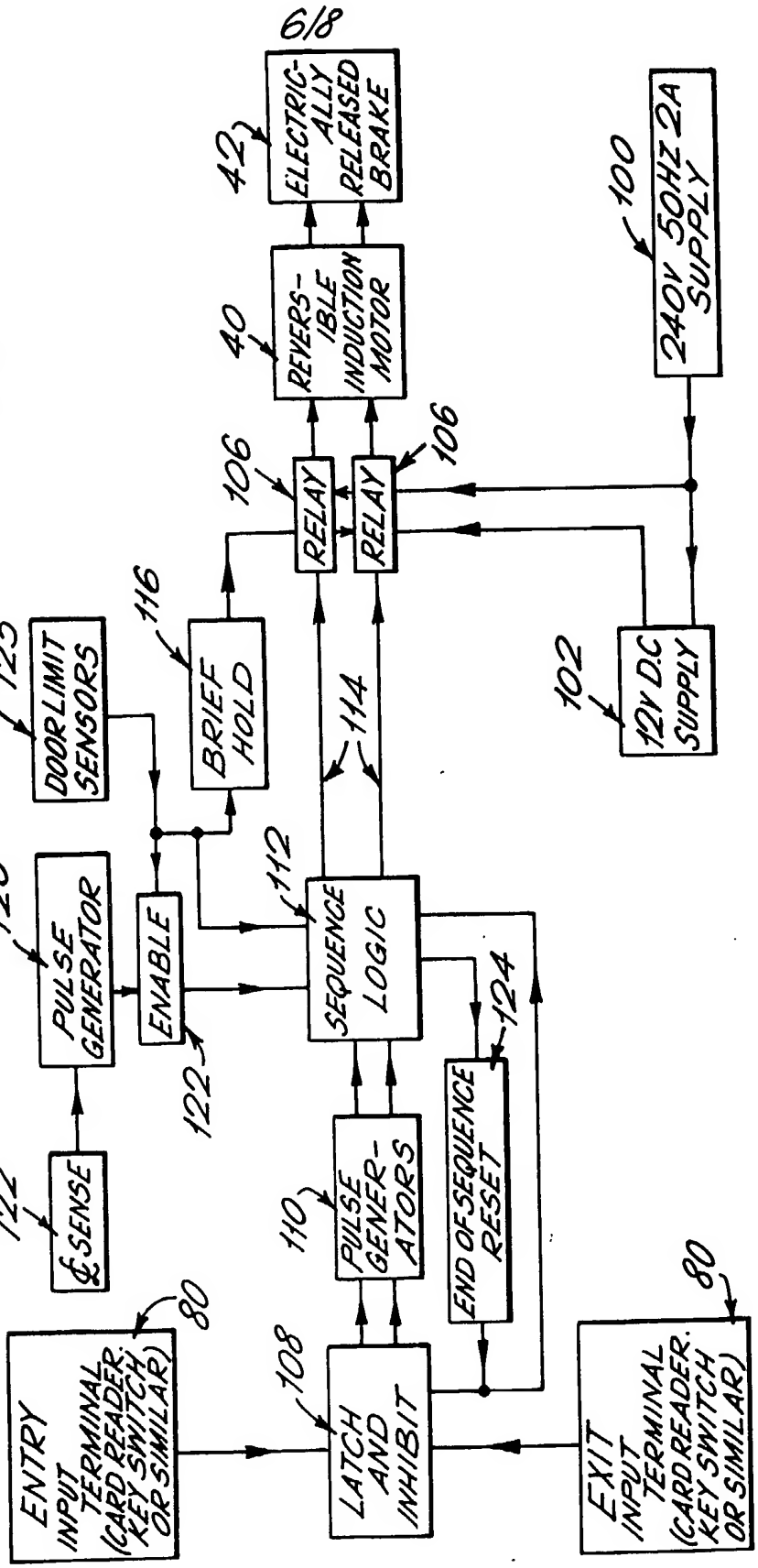


FIG.8.

FIG.9.


618
ELECTRIC-ALLY RELEASED BRAKE
42
REVERS-IBLE INDUCTION MOTOR
40
240V 50HZ 2A SUPPLY
100
106
RELAY
RELAY
106
721
723
DOOR LIMIT SENSORS
116
BRIEF HOLD
102
12V D.C SUPPLY
114
120
PULSE GENERATOR
ENABLE
112
SEQUENCE LOGIC
122
124
END OF SEQUENCE RESET
722
& SENSE
110
PULSE GENER-ATORS
80
ENTRY INPUT TERMINAL (CARD READER. KEY SWITCH OR SIMILAR)
108
LATCH AND INHIBIT
80
EXIT INPUT TERMINAL (CARD READER. KEY SWITCH OR SIMILAR)

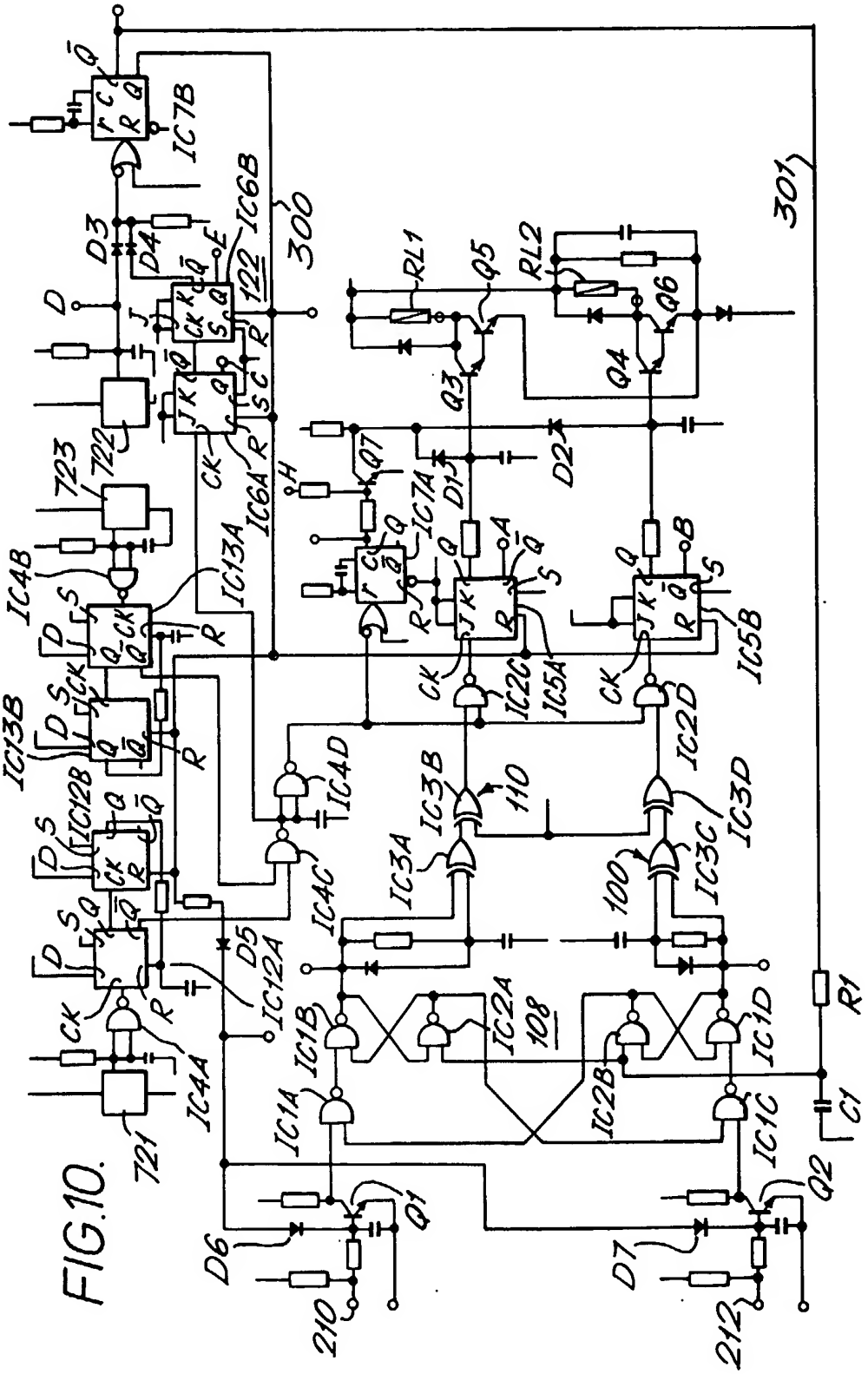
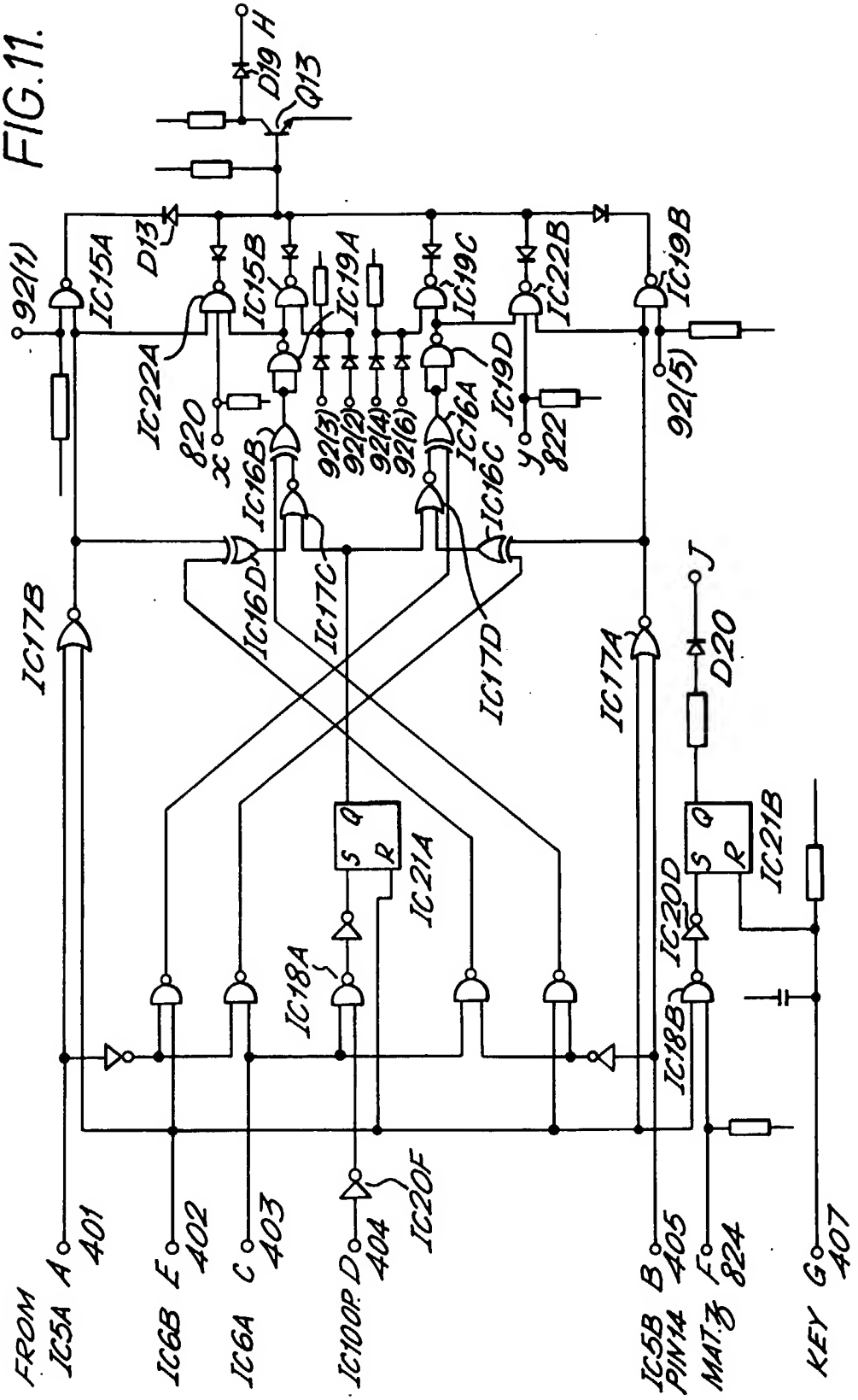

IC7B
IC6B
300
301
D3
D4
D
722
723
IC4B
IC13A
IC6A
IC13B
IC12B
IC4D
IC4C
IC3A
IC3B
110
IC2C
IC5A
IC7A
RL1
Q5
RL2
Q6
Q3
Q4
Q7
D1
D2
IC5B
IC2D
IC3D
100
IC3C
D5
IC12A
IC4A
721
IC1B
IC2A
108
IC1D
IC1A
IC2B
IC1C
R1
C1
Q2
Q1
D6
D7
210
212

FIG.10.

FIG.11.


D19 H
Q13
D13
92(1)
IC15A
IC15B
IC19A
IC19C
IC22B
IC19B
IC22A
820
x
IC16B
92(3)
92(2)
92(4)
92(6)
IC16A
IC19D
y
822
92(5)
IC16C
IC16D
IC17C
IC17D
IC17B
IC17A
J
D20
S Q
R
IC21A
IC21B
IC20D
IC18A
IC18B
FROM IC5A A 401
IC6B E 402
IC6A C 403
IC10OR D 404
IC20F
B 405
F 824
IC5B PIN14 MAT.3
KEY G 407

SPECIFICATION

Security door

This invention relates to security doors.

Security doors are commonly used in offices, factories and residential apartment blocks. It is an object of the present invention to provide a security door which permits exit and entry only of authorised persons and which is such as to provide a cycle of operation in which only one person or group of persons at a time can use the door.

The present invention provides a security door having a door compartment movable between three positions: (1) a first open position, (2) an intermediate closed position and (3) a second open position, means for driving the compartment between said three positions, and control means coupled to said drive means for controlling said drive means such that when said control means is actuated, said drive means moves said compartment from said intermediate position to one of said open positions, subsequently moves said compartment to the other of said open positions and then returns said compartment to said closed position, and means for preventing movement of the door other than by said drive means.

Thus in accordance with the invention only persons who have been instructed or have the means to actuate the control means can gain entry through the door.

The door is normally in the intermediate closed position and in this position it is impossible to gain entry or exit through the door. When the control means is actuated, the door moves from the intermediate closed position to one of the open positions where the person actuating the control means can step into the door compartment. The door then moves to the other open position and in this other open position the person can step out from the door compartment on the other side of the door. The compartment subsequently returns to the closed position in a state of readiness for any other person who wishes to gain exit or entry from the door.

The door may be an external door with one of the open positions communicating with the exterior of a building in which the door is situated and the other open position communicating with the interior of the building. Alternatively the door may provide a means of access between two interior parts of a building, for example an office or factory and here the open positions of the door communicate with the two parts of the building on either side of a barrier.

As preferred, the door comprises a door compartment which is pivotable within a frame between said three positions, a screen portion of the frame co-operating with the door compartment in the intermediate closed position to prevent access to the door compartment. The door compartment is preferably provided by two door leaves connected together along adjacent edges and forming an angle with one another, the sector shaped compartment thus defined being pivotable about an axis at or near said adjacent edges. Other forms of door may be envisaged; thus for example the door may have a door compartment which reciprocates between the two open positions. The door might conceivably be incorporated in a lift mechanism wherein the two open positions are disposed on different levels.

Said drive means may include an electric or hydraulic motor connected through a transmission including for example a clutch and suitable gearing for carrying out the desired sequence of movements in a cycle of operation of the door. Said means for preventing movement of the door other than by said drive means is important in that it prevents any person who wishes to enter the door pushing the door by hand to gain acess. Said means for resisting movement may be provided by a latch means which engages the door compartment whenever the drive means is not energised for preventing movement of the door. Alternatively the means for resisting movement may be incorporated in the drive means, the drive means being resistant to forces exerted on the door by a person seeking entry. For example gearing within the drive means may be such as to prevent movement of the door other than by operation of a motor attached to the gear means. As preferred as a positive and fail safe means for preventing movement, a brake means is provided which constantly engages the drive means to prevent movement of the door and is released from the drive means whenever the drive means is operative.

Said control means is coupled to said drive means preferably through electrical circuit means which registers actuation of the control means and monitors the position of the door compartment in order properly to control the drive means throughout a cycle of operation of the door. Sensors, such as Hall effect sensors, may be positioned within the door in order to detect in which of its three positions the door compartment is located. The control means, which is desirably manually operable by the person seeking access to the door, may be operated by a key insertable into a lock, movement of the lock causing actuation of the electrical circuit. Alternatively a card reader may be employed and a coded card may be inserted into the card reader by the person seeking access. As a further alternative a coded pushbutton control may comprise the control means. Other possibilities are available within the aim of preventing control means actuation by other than authorized personnel.

Said electrical circuit means may include a sequence logic circuit which is latched by

actuation of the control means and which is stepped by signals from the door position sensors so that the sequence logic circuit provides an output to the drive means to ensure that the drive means moves the door compartment in the correct direction to carry out the desired sequence of operation. Delay means will desirably be included in the electrical circuit for holding the door compartment in each of the open positions for a specific period in order to provide sufficient time for a person to enter or leave the door compartment.

Preferably a manually operable control means is provided on both sides of the door so that a person seeking access to the door may cause the door to operate no matter on what side of the door the person is situated.

Sensors should preferably be provided to arrest the powered motion of the door if the person using the door is about to physically impede the cycle of the moving compartment.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings where:—

Figure 1 is a perspective view of the preferred form of door according to the invention;

Figure 2 is a plan view of the door of Fig. 1;

Figure 3 is an elevational view of the door of Fig. 1;

Figure 4 is a sectional view along the line X–X of Fig. 2;

Figure 5 is a diagram of the sequence of movements of the door during a cycle of operation;

Figure 6 is a plan view of drive means for the door compartment of the door of Fig. 1, the drive means being located in the top of the door;

Figure 7 is an elevational view of part of the drive means with parts broken away to show the internal construction of the transmission of the drive means;

Figure 8 is a sectional view along the line Y–Y of Fig. 6 showing a journal for a transmission shaft of the drive means;

Figure 9 is a block diagram of the circuit means coupling the lock means of the door to the drive means;

Figure 10 is a detailed circuit diagram of the sequence logic control for the door; and

Figure 11 is a detailed circuit diagram of photobeam sequence enabling logic for the door.

Referring now to the drawings there is shown in Figs. 1 to 5 a security door of a reciprocating type having a semicircular frame member 2 within which the door can reciprocate about a central vertical axis 6. Frame member 2 comprises a top semicircular housing 8 containing drive means for the door compartment. The bottom of the frame member contains a semicircular rubber mat 10, beneath which as shown in Fig. 2 there are provided three pressure sensitive mat switches 820, 822 and 824.

Side pieces 12 extend from the top to the bottom of the frame and a flat glazed screen 14 extends between the side pieces 12 to define the back of the door. A screen 16 shaped as an arc of a circle extends between the top and bottom of the frame and is located centrally of the frame. The gaps between screen 16 and side pieces 12 define entry or leaving ports 18, 20 for the door. Spaced around the circumference of the door adjacent ports 18, 20, are located six light emitters 92 with corresponding receivers positioned vertically of the emitters within the openings.

The door compartment 4 is formed by two plane leaves 22 interconnected along a common edge 24. Vertical axis 6 is coincident with common edge 24. Leaves 22 are perpendicular to one another so as to subtend therebetween a quadrant. Reinforcing struts 26 are provided between screen members 22 at the top and bottom of the compartment. The door compartment is able to rotate within the frame member 2 about vertical axis 6 and flexible contact strips 28 are provided at the top, bottom and sides of the door compartment to prevent draughts through the door when the door is operated.

The vertical axis 6 is provided by a shaft 32 extending from the top to the bottom of the leaves 22, the bottom of the shaft 32 being located in a floor pivot bearing 30, and the top of the shaft 32 extending into the top housing portion 8 of the frame where it is connected to the drive means.

This is shown in more detail in Figs. 6 to 9, the drive means including a single phase reversible induction motor 40 having on one side thereof an electromagnetically operated shoe brake 42 and on the other side a reduction gear box 44. The parts 40, 42 and 44 comprise a commercially available unit available from Parvalux Ltd. The motor is a 1/8 horsepower 1400 r.p.m. motor coupled through the reduction gear box 44 providing a ratio of 48:1 to provide an output of 30 r.p.m. The shoe brake is arranged so as to clamp the motor stationary whenever the motor is not energised. Whenever the motor is energised the shoe brake is disengaged by a suitable electromagnetic arrangement.

The output shaft of the gear box 44 is coupled to a flexible coupling 46 comprising two toothed members 48 interconnected by a rubber toothed collar 50 engaging with the teeth of members 48. This permits misalignment between the output shaft of gear 44 and the remainder of the transmission. A transmission shaft 52 is coupled to flexible coupling 46 and is mounted in journals 54, one of which is shown in sectional view in Fig. 8. A spacing collar 56 is provided between the journals 54. Transmission shaft 52 is coupled

to a bevel gear 58 providing a 3:1 reduction ratio. Gear 58 comprises a bevel gear 60 coupled to a crown gear 62 mounted on a vertical shaft 64. A gear wheel 66 journalled on shaft 64 engages with a gear wheel 68 journalled on top of shaft 32 of the vertical axis 6 of the door compartment.

As shown in Fig. 6 gear wheel 68 carries on the periphery thereof a magnet 70 which moves with rotation of the gear wheel between three Hall effect sensors 72 disposed around the periphery of the gear wheel so as to operate the sensors sequentially during a cycle of operation of the door. Sensors 72 could be replaced by any other suitable sensing arrangement for sensing the movement of the door, for example photo cells or reed switches. However Hall effect sensors have been found to provide the most effective means of sensing movement of the door. As an alternative arrangement, three Hall effect sensors may be mounted on gear wheel 68 and a stationary magnet may be mounted adjacent the periphery of the gear wheel 68 so as to energise each sensor in turn as the sensors move to a position adjacent the magnet.

As shown in Figs. 2 and 3 and in block diagram form in Fig. 9, two card reader units 80 are provided, each unit being located on one of the side pieces 12 of the frame 2 of the door. These card units are of conventional construction and may be operated by a person possessing an appropriate card and a knowledge of the card coding. Actuation of the card unit by a person wishing to gain access to the door causes an electrical circuit shown in block diagram form in Fig. 9 to be actuated to energise motor 40 (and at the same time to release brake 42) to perform a desired sequence of operations. This desired sequence of operations is shown in Fig. 5.

As shown in Fig. 5/1, when the door is in its normal closed position, the door compartment 4 is positioned in an intermediate closed position in which circular screen member 16 co-operates with leaves 22 of the compartment to close the compartment. Thus in the closed position although the entry/exit ports 18, 20 are open, it is not possible to gain access to the door compartment which is held in an intermediate closed position and thus it is impossible to pass through the door. It will be noted that since brake 42 is normally in engagement with the motor 40 it is impossible to move the door compartment by pushing the door compartment.

When a person wishes to pass through the door it is necessary for that person to operate a card reader unit 80. Clearly the unit the person will operate will depend on which side of the door the person is initially situated. When a card reader unit 80 is actuated the circuits shown in Figs. 9 and 10 and to be described below are latched to energise motor 40 and to release brake 42 and to move the door compartment from the intermediate closed position to an open position on the side of the door on which the person is situated and to communicate with one of the exit/entry ports 18, 20. The progress of the moving compartment 4 is arranged to be arrested by an obstruction exerting pressure on mat switch 820, or interrupting light beams 92(1), 92(2), 92(3), the compartment 4 resuming motion immediately the obstruction is removed. Thus as shown in stage 2 of Fig. 5/2 the door compartment 4 has moved anticlockwise to the right to allow a person standing on the right hand side of screen 16 to enter the door compartment. In this second position the Hall sensors 72 (see Fig. 6) detect that the door is in an open position and pass a signal to the electrical circuit, the effect of which is to hold the door in the open position for a period of about 3 seconds to allow the person to step into the door compartment. Whilst the door is held in the stationary position the motor 40 is de-energised and the brake 42 is applied to prevent the door being pushed by the person entering the door compartment.

At the end of the 3 second period the circuit energises motor 40 in the opposite direction to move the door from the open position at approximately 4 revolutions per minute through the intermediate closed position (this being shown in Fig. 5/3), to the other open position as shown in Fig. 5/4. Light beams 92(3), 92(4), 92(5), 92(6) and mat switch 822 are operational while the compartment 4 is traversing from the position shown in Fig. 5/2 to position 5/3; and light beam 92(6) is in circuit while the door compartment 4 moves from position 5/3 to position as shown in Fig. 5/4. Thus any person obstructing a light beam mentioned above or exerting pressure on mat switch 822 will cause the door compartment 4 motion to stop.

The door compartment 4, now assuming the open position shown in Fig. 5/4, communicates with the other door exit/entry port 20 on the left hand side of screen 16. In this position a Hall effect sensor is energised to cause the electrical circuit to hold the door compartment in this open position for a period of 3 seconds to allow the person in the door compartment to leave the door compartment on the other side of the door. After this hold period of 3 seconds, the circuit operates to return the door compartment to the intermediate closed position as shown in Fig. 5/5. Door compartment 4 motion may be arrested by a person interrupting light beams 92(4), 92(5), 92(6) and/or exerting pressure on mat switch 824 when the compartment is travelling from the position shown in Fig. 5/4 to position 5/5. As the door compartment returns to the intermediate closed position, a

Hall effect sensor is energised to reset the electrical circuit, to de-energise motor 40 and to apply brake 42. Thus the door has now completed its cycle of operation and remains in its normal closed and locked position. When the door has attained this locked position shown in Fig. 5/5, the pressure sensitive mat switch 822 is enabled by the logic circuitry so that if a person had improperly entered the moving compartment 4 in its position as shown in Fig. 5/4 without operating the appropriate card reader unit 80, then upon reaching position 5/5 the mat switch 822 would be closed and would inhibit any further operations of the door until electrically reset. The person who improperly entered the door would then be contained within the compartment which would be held stationary by brake 42.

It would be preferred that the reset operation necessary to release such an improper entrant would be performed by an authorised person having access to a suitable switch, for example a key operated switch which, when operated, would energise brake 42, disable relays RL1, RL2 and resent all logic circuits. In this situation the door compartment could be moved manually to allow the person contained within the compartment to be escorted away. Upon re-positioning the compartment in the position shown in Fig. 5/5 and returning the key operated reset switch to its normal position, the door would assume its closed and locked position.

Referring to the block diagram of Fig. 9, a mains AC power supply shown as block 100 supplies current to the motor 40 via relays 106 and to a voltage regulating circuit shown as block 102 which converts the supply to a 12 volt DC supply for energising the electrical control circuit, the electrical control circuit being in the form of CMOS logic.

Card reading units 80 are connected to a latch and inhibit circuit 108. Circuit 108 operates when one card reader unit 80 is actuated to inhibit the other card reader unit, to prevent further operation of the card unit 80 which has been operated, and to initiate operation of the electrical circuit for moving the door through its cycle of operation. Thus latch and inhibit circuit 108 sends an appropriate signal to pulse generators 110. A pulse from generators 110 is passed to sequence logic circuit 112 which generates an appropriate signal on one of lines 114 to energise one of relays 106 and to hold the relay in its energised position so that power supply 100 can energise motor 40 and release brake 42 whereby the door compartment moves from the position shown in Fig. 5/1 to the position shown in Fig. 5/2. In the position shown in Fig. 5/2 the Hall effect sensor 72(1) senses proximity of the magnet 70 and passes a signal to sequence logic 112 and to a hold circuit 116 which is actuated to de-energise relays 106 whereby to de-energise motor 40 and to reapply brake 42, thus holding the door in the open position. The hold circuit operates for a period of about 3 seconds.

After such time, sequence logic 112 re-energises relays 106 along lines 114 to rotate the motor in the opposite direction from the position shown in Fig. 5/2, through the position shown in Fig. 5/3 to the position shown in Fig. 5/4. Hall effect sensor 72(3) then passes a signal to the sequence logic and to hold circuit 116. This holds the door in the open position for a period of about 3 seconds by virtue of relays 106 being de-energised to de-energise motor 40 and reapply brake 42. At the end of this period, sequence logic 112 provides an appropriate signal on lines 114 to energise relays 106 and thereby to energise motor 40 and release brake 42 to that the door moves from the position shown in Fig. 5/4 to the position shown in Fig. 5/5. In the position shown in Fig. 5/5, the central Hall effect sensor 72(2) provides a signal through pulse generator 120 and enable circuit 122 to reset along line 124 all of the electrical circuit so as to hold the door in readiness for a further cycle of operation. Enable circuit 122 is connected to receive signals from Hall effect sensors 72(1), 72(3) and the arrangement is such that enable circuit 122 is enabled to pass a signal from centre sensor 72(2) only when an appropriate number of signals from sensors 72(1), 72(3) have been received to indicate that the door is now reaching the end of its cycle of operation.

The sequence logic 112 also provides enable and disable signals at the appropriate times to activate light beams 92(1), 92(2), 92(3), 92(4), 92(5), 92(6) and mat switches 820, 822. Light beams 92(1), 92(2), 92(3) and mat switch 820 are enabled during the door compartment movement from the position shown in Fig. 5/1 to the position shown in Fig. 5/2. When the compartment is moving from 5/2 to position 5/3, light beams 92(2), 92(3), 92(4), 92(5), 92(6) and mat switch 822 are enabled. From position 5/3 to position 5/4, light beam 92(6) is enabled and from 5/4 to position 5/5, light beams 92(4), 92(5), 92(6) and mat switch 822 are enabled. At the position shown in Fig. 5/5 all light beams are disabled but the mat switch 824 is enabled.

It will be understood that a cycle of operation of the compartment initiated from the opposite side of the door would provide a similar logic sequence but the complement of the various light beams and mat switches would be enabled.

Referring now to Fig. 10 which is a detailed circuit diagram of the electrical circuit for controlling the drive means for the door, the card reader units 80 provide signals at terminals 210, 212. These signals are processed via transistor inverters Q1, Q2, through NAND

gates IC1A, IC1C. The other input terminals of IC1A, IC1C are cross-coupled as shown in a latch inhibit circuit 108 which also comprises two groups of cross-coupled NAND gates IC1B, IC2A and IC1D, IC2B. Thus a ground signal (a 0 signal) appearing at terminal 210 results in a 1 signal at the output of IC1B. Cross-coupled gates IC1B and IC2A are latched in this state with a 1 at the output of IC1B and a 0 at the output of IC2A. Since this 0 signal is applied to the input of gate IC1C, input terminal 212 will be disabled since no signal generated at 212 can change the output of IC1C. Since gates IC1B, IC2A are latched in the state with a 1 appearing at the output of IC1B, no further inputs from 210 can change the state of the latch/inhibit circuit.

The outputs of gates IC1B, IC1D are passed to pulse generators 110 made from EXCLUSIVE OR gates IC3A, IC3C, with IC3B, IC3D wired as inverters. Thus a 1 signal at the output of IC1B produces a zero pulse at the output of IC3B. (This output normally being at logic 1.)

The output from the pulse generators 110 are fed to a sequence logic circuit 112 which includes NAND gates IC2C, IC2D whose outputs are connected to BISTABLE gates IC5A, IC5B, the outputs of these gates being connected via current limiting resistors to transistor relay drivers Q3, Q5 and Q4, Q6. A relay coil RL1 is disposed in the collector circuit of transistor Q5 and a relay coil RL2 is connected in the collector circuit of transistor Q6. Thus a 0 pulse generated at the output of IC3B provides a 1 output for IC2C causing the output of BISTABLE gate IC5A to go to a logic 1. This 1 signal turns on transistor Q5 via Q3, thereby to energise the relay RL1. This causes motor 40 to run in the appropriate direction and causes brake 42 to release to allow the door compartment to move with the motor.

As the door approaches the open position shown in Fig. 5/2, Hall effect sensor 72(1) is energised to provide a 0 output to inverter IC4A followed by a series pair of D-type latches IC12A, IC12B. The action of latch IC12B changing state resets time constant RC network IC12A allowing a momentary 0 signal to the input of IC4C. Once triggered, IC12A and IC12B will stay latched until IC12B is reset at the end of a complete cycle of operations. NAND gates IC14C and IC4D wired as an inverter now pass a 0 signal to gates IC2C, IC2D, the outputs of these being applied to BISTABLE gates IC5A, IC5B so that IC5A output becomes 0 and IC5B output becomes 1.

The output from IC4C is also applied to the input of two BISTABLE gates IC6A, IC6B, connected in series for a purpose to be described. The output of IC4C is also applied to the input of a MONOSTABLE MULTIVIBRATOR IC7A. This provides a pulse approximately 3 seconds long at the Q output of IC7A in the form of a 1 signal which, via transistor driver inverter Q7, renders diodes D1, D2 conductive, grounding transistor Q3, Q4 bases and disabling any outputs from IC5A, IC5B. Thus in the period for which IC7A operates, relays RL1, RL2 are held off, motor 40 is de-energised and brake 42 is applied to prevent movement of the door. At the end of this time period, when the output of IC7A returns to a 0, the output of IC5B, which it will be recalled still provides a 1 signal, will be applied to transistor Q4 to energise relay coil RL2 via transistor driver Q6 and close the appropriate contacts in order to energise motor 40 in the opposite direction and release brake 42. The motor 40 will then move the door compartment through the position shown in 5/3 to the position shown in 5/4. In this position Hall effect sensor 72(3) provides a 0 output to inverter IC4B followed by series pair D-type latches IC13A, IC13B which provide a momentary 0 signal to IC4C and latch as previously described for IC12. This signal acts in the same manner as previously described on IC5A, IC5B to change the state of the outputs of these gates. Thus IC5A output will now be a 1, and IC5B output will now be a 0. MONOSTABLE IC7A also provides an approximately 3 second pulse to transistor Q7 and as previously described makes D1, D2 conductive thus holding off Q3, Q4 and drivers Q5, Q6 whereby to hold the door compartment in the open position shown in Fig. 5/4 for the time period. At the end of this period the signal which is available at the output of IC5A switches on transistors Q3, Q5 to energise relay RL1 so that motor 40 moves door compartment 4 back to the position shown in Fig. 5/5. In this position Hall effect sensor 72(2) provides a 0 output. It will be understood that a 0 output is provided by sensor 72(2) each time the door passes through the central position but this signal is normally ineffective by virtue of circuit 122 which prevents the output from reaching the sequence logic. In the position shown in Fig. 5/5, since the counters IC6A, IC6B have received signals from both sensors 72(1), 72(3) via IC4C, the output of IC6B goes low whereby to enable diode gate D3, D4. The 0 signal provided by sensor 72(2) causes a pulse to be generated by MONOSTABLE IC7B, a 0 at the $\overline{Q}$ output 301 and a 1 at the Q output 300. The reset line 300 now resets IC6B, IC6A, IC5A, IC5B, IC13B (which in turn resets IC13A), IC12B (which in turn resets IC12A) and also momentarily inhibits inputs 210, 212 via diodes D5, D6, D7. Reset line 301 resets IC2B, IC2A which in turn unlatch IC1D, IC1B, IC1C, IC1A. The effect of this is to de-energise motor 40 and to reapply brake 42, thus to hold the door in the central position. The door is thus in a

state of readiness or its next cycle of operation.

It will be understood that the sequence of operations is similar if input terminal 212 is activated by the appropriate card reader unit rather than input terminal 210 as described above.

When power is first applied to the circuit, or after a mains failure, capacitor C1 and resistor R1 ensure that input latch 108 is reset.

The six light emitters and associated receivers 92(1) to 92(6) are sequentially enabled so as to inhibit movement of the door compartment if a person or other obstacle is in such a position as physically to impede the powered operation of the unit. Referring to Fig. 10A in conjunction with Fig. 10, when the door compartment is in the closed central position shown in Fig. 5/1, 401 is high, 402, 403 are low, 404, 405 are high and 824, 407 are low.

Grounding input 210 as previously described toggles IC5A making 401 go low, so that NOR gate IC17B output provides a 1 allowing photo receiver output 408 to send low the output of NAND gate IC15A, making diode D13 conductive, and pulling down the base of transistor Q13 which is wired as an inverter. This makes diode D19 go conductive and turns on transistor Q7 which in turn inhibits any signals via D1, D2 from IC5A, IC5B, thus holding off relays RL1 or RL2. In this condition, motor 40 is de-energised and brake 42 is applied to prevent movement of the door.

Similarly photo receivers 92(3), 92(2) are enabled to inhibit motor 40 due to IC16D output changing to a 0, this signal being gated through IC17C and IC16B, inverted by IC19A and enabling gate IC15B. Also triple input NAND gate IC22A now has two inputs with a 1 signal applied, enabling mat switch 820 to inhibit door motion. When door compartment reaches the position shown in Fig. 5/2 input 403 changes state due to Hall effect sensor 72(1) and its associated circuitry.

After the time interval provided by IC7A as previously described, input 405 goes low, changing the output state of IC17A to a 1 and enabling photo reciver 92(5) via gate IC19B. IC16C output now goes low and via gates IC17D, IC16A, IC19D enables gate IC19C to accept a signal from photo receivers 92(4), 92(6). Also gate IC22B now has two inputs with a 2 signal applied enabling mat switch 822 to inhibit door motion. When the door compartment reaches the position shown in Fig. 5/3, a pulse is provided by sensor 72(2), arriving at 404, inverted by IC20F, gated with a 1 output from 403 by IC18A to toggle IC21A, providing a 1 to input of IC17D. This resets gates IC16A, IC19D and IC19C so inhibiting the outputs of light receivers 92(4), 92(6) and mat switch 822.

A pulse is provided from sensor 72(3) to activate input 401 with a 0 signal and as IC6B toggles, input 402 receives a 2 signal. As both inputs to IC17B are inverted, no change is experienced at the output, so gate chain IC17B, IC15A, IC16D, IC17D, IC16B, IC19A, IC15B and IC22A are not sequenced, whereas IC17A, IC16C, IC17D, IC16A and IC19D outputs are all inverted, enabling gates IC19C, IC19B and IC22B to accept any signals from light receivers 92(4), 92(6) and 92(5) and mat switch 822.

All these gates are reset to the standby position when the door compartment reaches position 5/5 at which time gate IC18B has been enabled via IC6B output to accept a 1 signal from mat switch 824. Inverter IC20D passes a 1 signal to latch IC21B the Q output of which going high makes diodes D20, D6 and D7 conductive, inhibiting any commands to inputs 210, 212.

A reset facility is provided by a key operated switch providing a 1 signal to IC21B. Other contacts on this key switch also energise brake 42 allowing the door compartment to be manually moved.

There has thus been described a security door having a compartment which is movable between two open positions on either side of an intermediate closed position, the door being actuated in response to operation of a locking means, preferably a card reader unit which activates logic circuits to enable the door to carry out a cycle of operations. A drive means for driving the motor throughout its cycle of operation includes a brake which prevents movement of the door other than by the drive means. Thus it is not possible to push the door manually between its various positions. Various modifications to the described embodiment may be envisaged. For example the invention may be applied to doors merely having two open positions on either side of a barrier, no central position being provided, the door remaining locked in a compartment-open position until a person wishing to pass through the door actuates the lock means so that the compartment can move to the other open position. As a further modification, the door may be provided with a door compartment which is sufficiently large to accommodate more than one person.

CLAIMS

1. A security door comprising a door compartment movable between first and second open positions through an intermediate closed position, means for driving said compartment between said positions, control means operable to cause said driving means to move said compartment through a sequence of movements including movement from said intermediate closed position to a respective one of said open positions, subsequent movement to the other of said open positions, and subse-

quent return movement to said intermediate closed position, and means to prohibit movement of the door compartment other than by operation of said control means.

2. A security door as claimed in claim 1 wherein said door compartment is pivotable within a frame between said first and second open positions and said closed position, a screen portion of the frame co-operating with the door compartment in the intermediate closed position to prevent access thereto or egress therefrom.

3. A security door as claimed in claim 2 wherein said door compartment is defined between two door leaves connected together along adjacent edges and forming an angle with one another, said two leaves being pivotable together about an axis at or near said adjacent edges, and said frame is arcuate with inlet and outlet ports adjacent the ends thereof for coperation with said door compartment in its open positions.

4. A security door as claimed in any of the preceding claims wherein said means for driving the door compartment comprises a motor controlled by said control means and provided with a positive braking device adapted to prevent movement of the door compartment except when the motor is actuated by the said control means.

5. A security door as claimed in any of the preceding claims where said control means is operable to cause said driving means to move said compartment only in response to predetermined operation by an intending use of the door of a unit accessible from outside of the door for precluding use of the door by other than an authorised user.

6. A security door as claimed in claim 5 wherein said unit comprises a card reader unit, one such unit being provided accessible from outside of the door at or adjacent each of the door open positions.

7. A security door as claimed in any of the preceding claims wherein said control means includes sensors arranged to provide to the control means signals indicative of the position of the door in its cycle of movement, which signals are used in controlling the movement of the door.

8. A security door as claimed in claim 7 wherein said sensors include Hall effect sensors.

9. A security door as claimed in claim 7 or 8 including sequence logic circuitry for determining the movements of the door compartment in response to inputs thereto derived from said sensors and from a manually addressable input terminal provided adjacent each of said door open positions so as to be accessible from outside of the door compartment, said sequence logic circuitry including means responsive to addressing of one of said input terminals for initiating an operational sequence comprising inhibiting the sequence logic circuitry against response to subsequent addressing of either of said input terminals until the response sequence to the just-addressed input terminal has been completed, enabling powered movement of the door compartment to the open position adjacent to the addressed input terminal, arresting the movement of the door compartment in dependence upon a signal from an appropriate sensor indicative of arrival of the door compartment at its respective open position, holding the door compartment in such open position for a predetermined period, subsequently enabling powered movement of the door compartment to the other of its open positions, arresting the movement of the door compartment in dependence upon a signal from a further appropriate sensor indicative of arrival of the door compartment in such other open position, holding the door compartment in such other open position for a predetermined period, and then enabling powered movement of the door compartment back to its closed position and terminating the sequence of movement of the door compartment in such closed position subject to receipt of a signal from a corresponding sensor.

10. A security door as claimed in claim 9 wherein the door compartment is powered by means of a reversible electric motor, wherein the supply of power to drive the motor is determined by switches set by the said sequence logic circuitry in dependence upon signals provided thereto by said input terminals and sensors, said input terminals being connected to said sequence logic by way of a cross-coupled latch-and-inhibit circuit adapted until reset to be responsive only to the first-actuated one of said input terminals to apply a corresponding signal to the sequence logic for initiating operation of the motor in a direction such as to power the door compartment towards the port associated with the said first-actuated input terminal, a door compartment position sensor being associated with each of said first and second open positions and said closed position of the door compartment and being arranged for providing to the sequence logic circuitry signals to enable the sequence logic circuitry to set said switches in accordance with the required direction of movement of the door compartment, and time delay means associated with the position sensors corresponding to the two open positions of the door for introducing a predetermined interruption into the motor operation as determined by the sequence logic circuitry when the door compartment moves into either of its open positions.

11. A security door as claimed in any of the preceding claims including means to inhibit execution of a cycle of operation of the door compartment in the event that an obstacle hinders corresponding movement of the door compartment.

12. A security door as claimed in claim 11 including floor-mounted pressure-sensitive switches associated with each of the first and second open positions and the intermediate closed position of the door for sensing the presence of an obstacle in a position such as to impede the movement of the door compartment, and means for interrogating said switches in predetermined sequence during a cycle of movement of the door compartment to determine whether the cycle can be permitted to proceed.

13. A security door as claimed in claim 12 further including beam generating and receiving means located in each of the frame ports for detecting the presence of an obstacle in either of the ports by the interruption of the corresponding beam, and means for interrogating said beam receiving means in predetermined sequence in a cycle of movement of the door compartment to determine whether the cycle can be permitted to proceed.

14. A security door as claimed in any of the preceding claims and wherein the mechanical arrangement of the door is substantially as herein described with reference to Figs. 1 to 4 of the accompanying drawings.

15. A security door as claimed in any of the preceding claims and wherein the arrangement of the electric motor and associated brake means for determining the movement of the door compartment is substantially as herein described with reference to Figs. 6, 7 and 8 of the accompanying drawings.

16. A security door as claimed in any of the preceding claims and wherein the general electrical arrangement of the door is substantially as herein described with reference to Fig. 9 of the accompanying drawings.

17. A security door as claimed in claim 16 and wherein the electrical arrangement is furthermore substantially as herein described with reference to Fig. 10 of the accompanying drawings.

18. A security door as claimed in claim 17 and wherein the arrangement of mat switches and light beam generator/receiver units and the electrical arrangement thereof is substantially as herein described in Figs. 2, 5 and 11 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.